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# PATENT SPECIFICATION

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DRAWINGS ATTACHED

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## (54) LEATHER SHOE SOLE CONTAINING MULTIPLE POLYURETHANE PLUGS

(71) I, STEPHEN CHELMINSKI, a citizen of the United States of America, of R.F.D. 1, Valley Road, West Redding, Fairfield, Connecticut, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

Although there are many different types of shoe soles available today, I have found that shoes having a leather sole are most comfortable on my feet. I attribute this to the natural breathing characteristics of leather and to its ability to absorb moisture from my feet. However, it has been my experience that when I attempt to wear leather soled shoes while working on concrete and cinder floors, the soles wear out in three or four months. Also, it has been my experience that leather soles will occasionally slip or skid upon a wet or smooth surface or upon a wood surface.

It is an object of the present invention to provide shoes having soles and/or heels of leather or leather substitute so that the shoes have the comfortable wearing characteristics of leather while, at the same time, having durable, wear-resistant characteristics and providing greatly increased traction. It is a further object of the present invention to provide shoe soles and/or heels having a more uniform wearing character than leather soles or heels themselves.

According to one aspect of the present invention, there is provided a method of making a shoe sole and/or heel of leather or leather substitute having improved wear-resistance and non-skid characteristics, including the steps of perforating the lower surface of the sole and/or heel to form a plurality of holes, and introducing polyurethane material into the holes to form plugs of polyurethane material therein, positioned so as, in use of the sole and/or heel, to engage a surface upon which a user is walking.

According to another aspect, there is provided a shoe sole or heel of leather or leather substitute, having a lower surface provided

with a plurality of perforated holes therein, and a plurality of polyurethane plugs secured in said holes, and plugs being exposed through the lower surface in position so as, in use of the sole or heel, to engage a surface upon which a user is walking.

The invention also consists in a shoe having a sole and/or heel as above defined.

The plugs are set in place by being inserted, poured or injected into these holes and secured in place; for example, thermoplastic polyurethane may be heated, inserted and then allowed to set by cooling and hardening, and polymerizable polyurethane may be set in place by inserting it into the holes in liquid form and then curing it therein so as to form bonded plugs of polyurethane.

As used in the specification and appended claims, the term "lower surface" is intended to mean that surface of the sole or heel which, in use of the sole or heel, engages a surface upon which a user is walking.

As used in the specification and appended claims, the term "perforated holes" is intended to include openings formed in the leather sole by any one or more of the operations of drilling, boring, punching, or the forming of holes by the operation of displacing the leather material outwardly away from the axis of the hole by means of a tapered or wedge-shaped pointed tool. The perforated holes may have generally cylindrical walls, or the walls may be tapered or stepped.

In order that the present invention may be more fully understood, reference will now be made to the accompanying drawings, in which:—

FIGURE 1 is an elevational sectional view showing a man's shoe embodying the present invention;

FIG. 2 is a plan view of the bottom of the sole of the shoe and heel shown in FIG. 1;

FIG. 3 shows a portion of the sole of a shoe similar to FIG. 1 in which the polyurethane plugs are tapered;

FIG. 4 shows a portion of the sole of a shoe similar to FIG. 1 in which the poly-

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urethane plugs are stepped in configuration;

FIG. 5 shows an elevational sectional view of a man's shoe similar to FIG. 1 in which the entire walking surface of the heel is polyurethane.

Referring to FIGS. 1 and 2 of the drawings in greater detail, a shoe 10 is shown having a sole 12 including a plurality of layers of leather 14, 16 and 18. The lower-most layer 14 and the next layer 16 are perforated by a multiplicity of perforated holes 20. As shown in FIG. 2, these holes 20 are arranged in a pattern in the area 22 of the sole 12 which usually bears with the greatest pressure against the surface upon which the user is walking. This is the area 22 which usually is subjected to the most wear, and, generally speaking is located between the tips of the toes of the foot and the arch of the foot.

The perforated holes 20 are preferably formed in the outer and intermediate layers of sole 14 and 16 before these layers 14 and 16 are attached to the inner sole 18. These holes 20 are filled with polyurethane before the layers 14 and 16 are attached to inner sole 18. In one method of accomplishing this, the two layers 14 and 16 are held flat on a surface containing a urethane parting, i.e. releasing agent, such as a silicone or polytetrafluoroethylene spray coated surface. As the layers 14 and 16 are held flat on this parting surface, the holes are filled with liquid polyurethane which is unpolymersized. Preferably, the parting surface has a heated metal plate beneath it for the purpose of maintaining the polyurethane material at the proper temperature for curing.

The polyurethane material cures in the perforated holes 20 to form plugs 28. After the plugs 28 have cured, the leather layers 14 and 16 are removed from the parting surface, and thereafter the layers 14 and 16 are attached to the inner sole 18 of the shoe in conventional manner. In this way, the multiple polyurethane plugs 28 are exposed at the bottom of the sole to engage the surface upon which the user is walking.

These polyurethane plugs 28 provide greatly enhanced traction on slippery surfaces. Moreover, these plugs 28 resist uneven wear of the shoe sole.

The heel 30 includes a lowermost leather layer 34 and an intermediate layer 36 and a layer 38 adjacent to the sole 12. The layers 34 and 36 have perforated holes 40 formed therein. Polyurethane plugs 42 are cast in the holes 40 in a manner similar to the casting of the plugs 28. Thereafter, the heel 30 is attached to the shoe in the conventional manner. The heel plugs 42 also provide enhanced traction as well as resistance to uneven heel wear.

In this example, the plugs 28 in the sole are smaller in diameter than the plugs 42 in the heel. The plugs 28 are, for example, of a size in the range from 1/32nd of an inch to 1/2 of an inch in diameter, while the plugs

42 are, for example, of a size in the range from 3/16ths of an inch to 3/4ths of an inch in diameter.

In order to secure the plugs 28 and 42 more firmly in place, it is preferable to prime the perforations 20 and 40 with a suitable liquid adhesive primer for polyurethane which is sprayed into the perforations before the polyurethane is introduced.

It is to be noted that the holes 20 and the plugs formed therein are generally staggered in position. They are located such that the transverse spacing T is greater than the longitudinal spacing L. The reason for this spacing arrangement is that the major amount of flexing during walking occurs about a transverse axis, i.e. the toe tends to be bent upwardly. The greater transverse spacing T helps to resist cracking of the leather in the region between holes.

It is also to be noted that the pattern of holes (and the plugs formed therein) includes a curved line from 24 to 24 which is as close as possible to the outside edge 26 of the sole, because in most cases people tend to wear the region of the sole near the outside edge faster. This pattern arrangement resists uneven wear and provides good traction.

The plugs 28 and 42, if desired, advantageously project down below the bottom of the sole layer 14 to provide traction lugs for outdoor sporting activities, such as golf. These projecting lugs of polyurethane have the advantage that the user can walk into a building having a conventional floor without damaging the floor.

Figure 3 illustrates the sole of a shoe like that shown in FIGS. 1 and 2, except that the perforated holes 20a are tapered. When the polyurethane plugs 28 are cast therein, they have a similarly tapered shape.

Figure 4 illustrates the sole of a shoe like that shown in FIGS. 1 and 2, except that the perforated holes 20b have stepped walls. The polyurethane plugs 28 cast therein have a corresponding stepped shape.

Figure 5 shows a shoe similar to that shown in FIGS. 1 and 2, except that the lowermost leather layer 34 of the heel 30 is omitted, and the heel is covered by a layer 44 of polyurethane bonded to the base layer 36 of the heel.

In the foregoing description, the polyurethane is introduced into the perforations 20, 20a, 20b and 40 in liquid form and is subjected to heating to cause it to cure, i.e. polymerize, in place in the perforations. Instead of placing the plugged sole material adjacent to heated plates for curing the polyurethane plugs, the soles may be placed in an oven to supply the heating.

For accomplishing the sole perforation and liquid polyurethane injection, the sole or heel blank is clamped onto a movable work table. The table is moved to a first position at which

the perforated holes are made at predetermined points in the sole or heel. Then the table is shifted to a second position in which the perforations in the sole become registered with a plurality of nozzles for spraying in the adhesive primer. Then the table shifts to a third position in which the respective perforations are registered with a group of nozzles for injecting the liquid polyurethane.

In a presently preferred method of introducing the polyurethane material into the perforations 20 and 40, thermoplastic polyurethane is heated sufficiently to flow and then the fluid is injected into the respective perforated holes. It is cooled and hardened in place to form the plugs 28 and 42. It is preferred to prime the perforations with an adhesive primer before the fluid polyurethane is introduced.

The manner in which this is accomplished is to clamp the sole or heel onto a movable work table, as discussed above. Perforated holes are made at predetermined points, while the table is at a first position, and then the table is shifted to a second position in which the primer is applied. The table is shifted to a third position in which an injection head has a plurality of orifices each one registering with a predetermined perforated hole 20, 20a, 20b or 40. A plunger is associated with each orifice. These plungers serve to force previously heated thermoplastic polyurethane, which has been heated to the flow point, into the perforations. The fluid polyurethane is cooled to form the plugs 28 and 42.

If desired, the thermoplastic polyurethane material can be metered as follows. It is supplied to the respective orifices in the injection head in the form of small rods. These are sheared off in the injection head by a shear plate which thereby forms a plurality of small solid cylindrical slugs, each of which contains the desired amount of polyurethane. The slugs are heated to become fluid and are then injected by the plungers through the orifices into the perforations.

Rather than injecting the thermoplastic polyurethane in fluid form, the small solid cylindrical plugs can be forced by the plungers into the respective perforations. Then the sole is heated sufficiently to fluidize the polyurethane which is then allowed to cool to secure the plugs in place.

If desired, a small pre-formed solid cylindrical slugs of polyurethane can be similarly injected into the perforations containing an adhesive. This adhesive serves to cement the solid slugs in place to form the plugs 28 and 42.

This invention can also be used to provide plugs 28 distributed over the entire area of the sole. When the plugs 28 are of such small diameter that it does not matter whether they occur at the edge of the sole, then a sheet of the sole material 14 or 14 and 16 can be filled with the plugs 28 before the sheet is

cut into individual blanks. After the plugs 28 are formed, the sole blanks are cut from it. I have found that the sole stitching can pass through the plugs just as well as through the sole material itself, and therefore the exact location and positioning of the plugs 28 is not critical when they are of small diameter.

With respect to the insertion of polymerizable polyurethane into the perforated holes, as discussed above, it is advantageous from the point of view of ease of handling to mix the polyurethane with its catalyst and to freeze it to prevent polymerization. The frozen, premixed polyurethane is inserted into the respective perforated holes in the form of slugs of the proper size. Then, the sole and plug assembly, or heel and plug assembly is heated to cause the plugs 28 and 42 to set in place by curing.

Although leather is the preferred and best material because of its comfortable breathing characteristics, other leather-like materials for the soles or heels could be used as a leather substitute, with the polyurethane plugs 28 and 42 being set in perforated holes in such material in the methods, as described above.

#### WHAT I CLAIM IS:—

1. A method of making a shoe sole and/or heel of leather or leather substitute having improved wear-resistance and non-skid characteristics, including the steps of perforating the lower surface of the sole and/or heel to form a plurality of holes, and introducing polyurethane material into the holes to form plugs of polyurethane material therein, positioned so as, in use of the sole and/or heel, to engage a surface upon which a user is walking.

2. A method as claimed in claim 1, which comprises casting liquid polyurethane material into the holes, and allowing the liquid polyurethane material to set in place to form said plugs.

3. A method as claimed in claim 2, which includes heating thermoplastic polyurethane material sufficiently to flow, introducing the flowable thermoplastic polyurethane material into the holes, and setting the heated thermoplastic polyurethane material in place to form the plugs, by reducing its temperature.

4. A method as claimed in claim 3, in which the thermoplastic polyurethane material is metered by supply, the material in rods, shearing off the rods to form slugs each containing the desired amount of material, and heating the slugs sufficiently to flow for introduction into the holes.

5. A method as claimed in claim 1, which includes the steps of introducing slugs of solid polyurethane material into the respective holes, and heating the assembly of the lower surface and the slugs to form the slugs into plugs set in the holes.

6. A method as claimed in claim 5, in which the slugs are thermoplastic, and the heating step heats the assembly of the lower surface

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- and thermoplastic material sufficiently to cause the material to flow into conformance with the holes, the method including the step of cooling said assembly so as to cause said material to become set securely as plugs in the holes.
- 5 7. A method as claimed in claim 5, in which the slugs are pre-mixed polymerizable polyurethane and a catalyst which have been cooled to a temperature below that at which the material polymerizes and the heating step serves to heat the assembly of slugs and the lower surface to cause the material to polymerize to form plugs set securely in said holes.
- 10 8. A method as claimed in any preceding claim, in which an adhesive primer is introduced into the holes before the polyurethane material is introduced.
- 15 9. The methods of making a shoe sole and/or heel substantially as hereinbefore described with reference to the accompanying drawings.
- 20 10. A shoe sole and/or heel made by the method claimed in any preceding claim.
- 25 11. A shoe including a sole and/or heel as claimed in claim 10.
- 30 12. A shoe sole or heel of leather or leather substitute, having a lower surface provided with a plurality of perforated holes therein, and a plurality of polyurethane plugs secured in said holes, said plugs being exposed through the lower surface in position so as, in use of the sole or heel, to engage a surface upon which a user is walking.
- 35 13. A shoe sole or heel as claimed in claim 12, in which the polyurethane plugs are cast
14. A shoe sole as claimed in claim 12 or 13, wherein the holes are arranged in an arcuate pattern following the outside edge of the sole, and are spaced more widely in a transverse direction than they are in a longitudinal direction.
- 40 15. A shoe sole or heel as claimed in claim 12, 13 or 14, wherein the polyurethane plugs project down below the lower surface to provide traction lugs for use in sporting activities on earth, said traction lugs being capable of being used upon conventional building floors without damaging the floors.
- 45 16. A shoe sole and/or heel constructed substantially as hereinbefore described with reference to Figures 1 and 2 of the accompanying drawings.
- 50 17. A shoe sole constructed substantially as hereinbefore described with reference to Figure 5 of the accompanying drawings.
- 55 18. A shoe sole and/or heel as claimed in claim 16 or 17, modified in accordance with Figure 3, or Figure 4, of the accompanying drawings.
- 60 19. A shoe having a sole and/or heel as claimed in any of claims 12 to 18.
- 65 20. A shoe having a sole as claimed in any of claims 12 to 18, and a heel, the entire lower surface of which is polyurethane.

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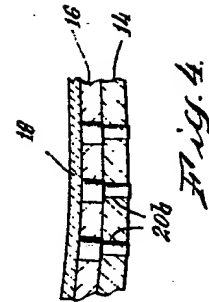
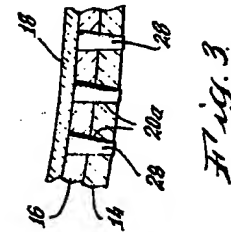
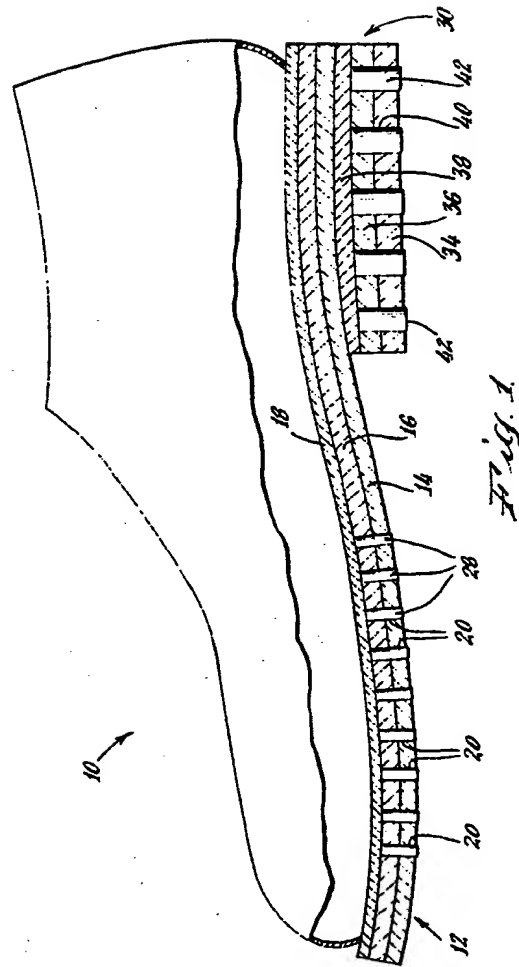
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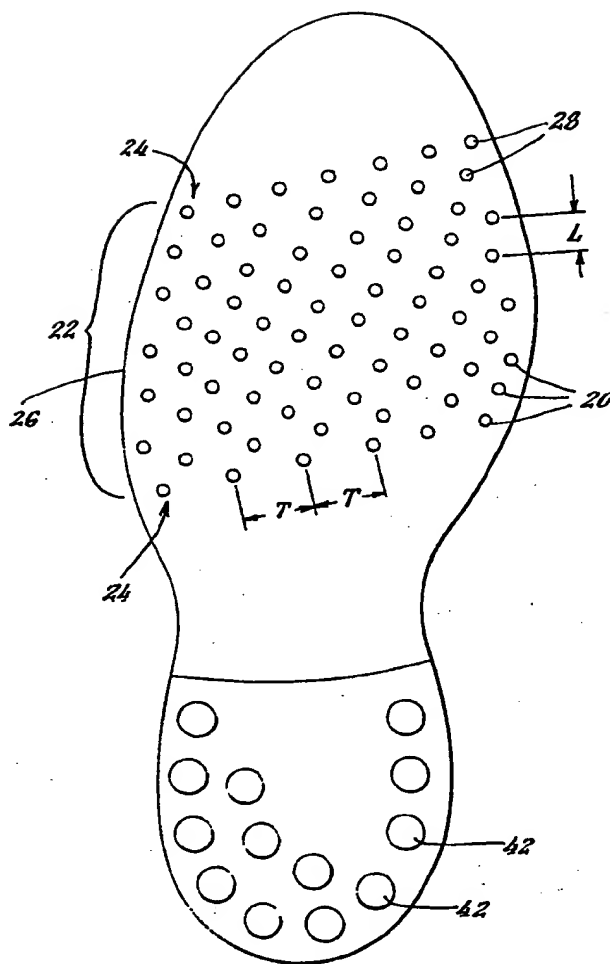
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*Fig. 2.*

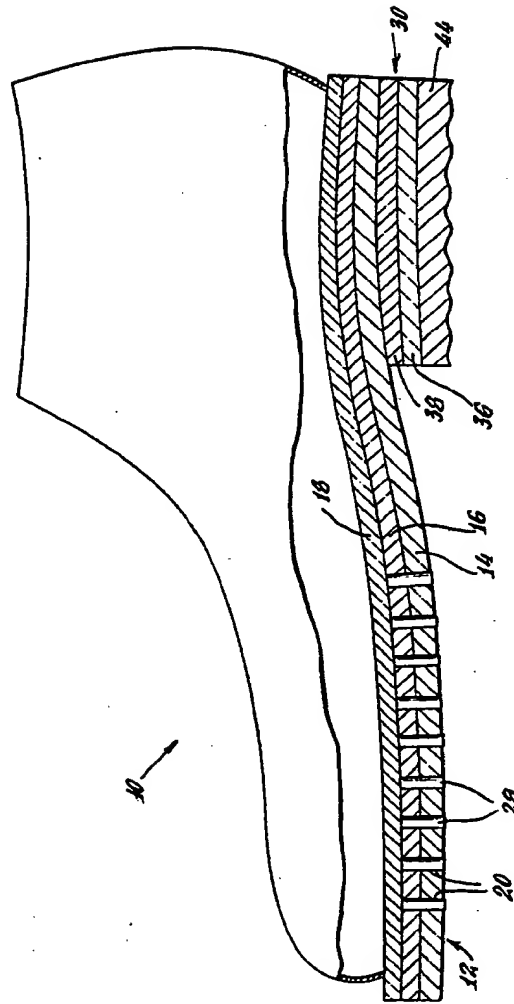
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Sheet 3



*Fig. 5.*